SMMOA Supply, Maintenance, Monitoring Open Architecture

Presented by
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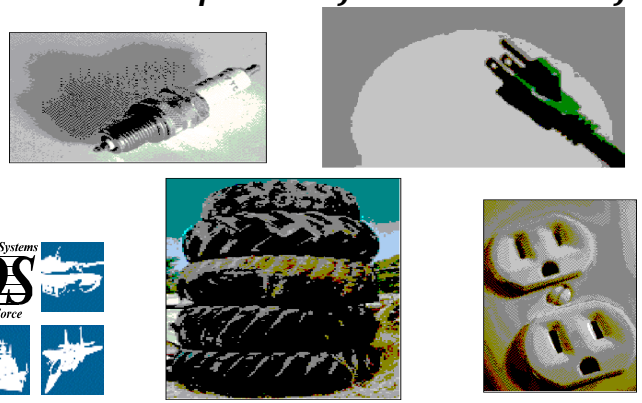
Open Systems Architecture

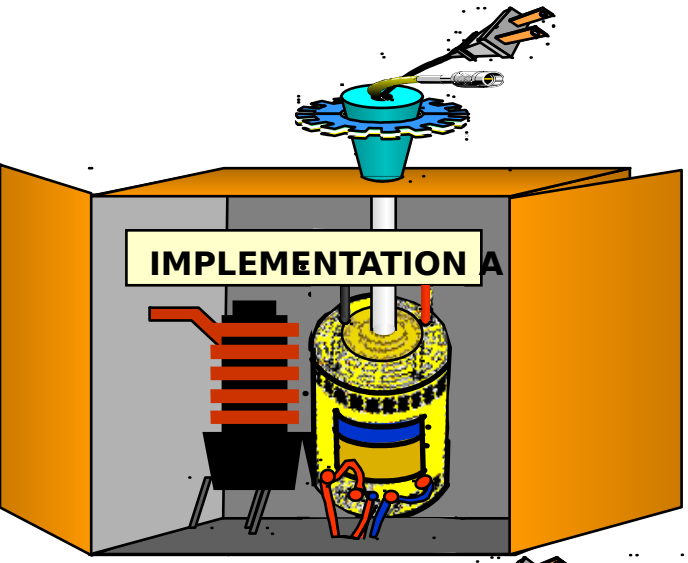
- The **Open System Architecture (OSA)** concept was developed by the **computing industry** in the 1970's and 1980s to help compatability among vendors, thus reduce costs.
- Involves defining an architecture and "**open standards**" for interfaces within that architecture
- Multiple companies are then free to build (innovative) products that "plug into" open standard
- **Widely used throughout Information Technology (IT) Industry**

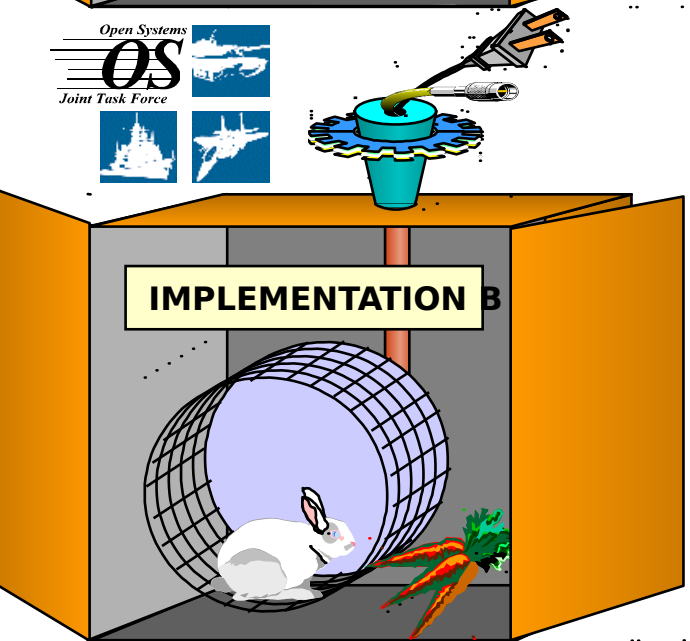
Examples of OSA Interfaces



"Plug and Play" Storage Devices for common interface

Open Systems Approach





Industry can choose <u>any</u> implementation (including proprietary) to meet OSA interface

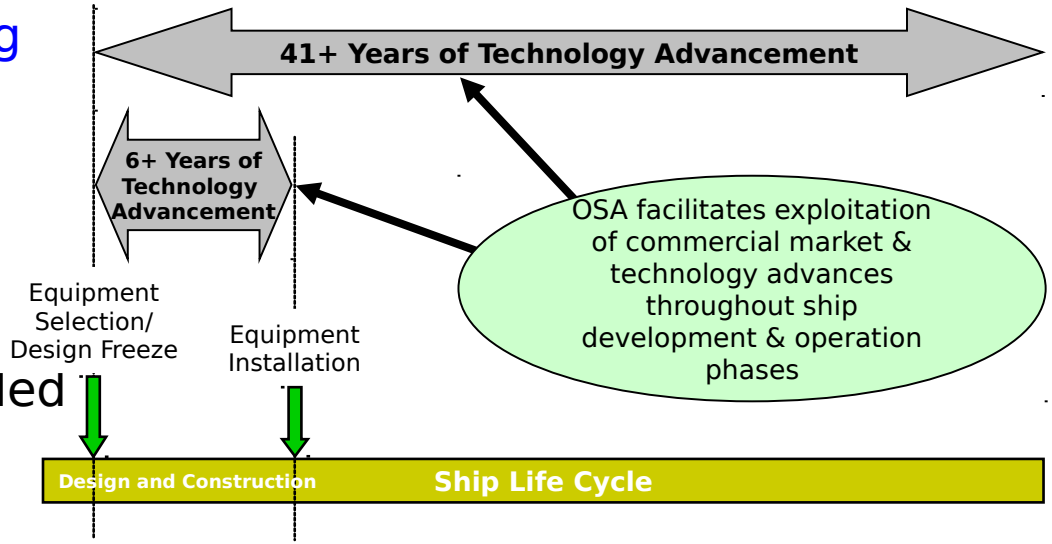
Acquisition of System = **Performance Specification** + **OSA Interfaces**

Performance Spec
- Performance
- Envelope
- Human Factors
- Power consumption
- ILS docs

OSA Interfaces
- Physical (Geometric & Tolerances)
- Electrical
- Air interfaces
- Cooling interfaces
- Control Sensors, Monitoring interfaces
- Piping connections
- Human Factors
- Survivability/Vulnerability: shock/vibration/EMI/EMC
- CG / VCG

DoD/Navy Unique Need

- Platforms with increasingly long lifecycles (30+ years)
- Increased used of commercial technologies
- Short lifecycles of COTS (<7 years)
  - Often obsolete by time fielded

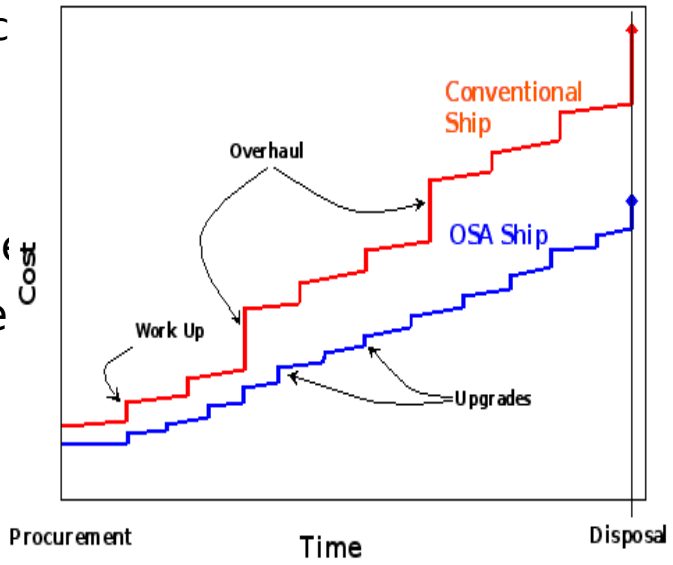

41+ Years of Technology Advancement
6+ Years of Technology Advancement
OSA facilitates exploitation of commercial market & technology advances throughout ship development & operation phases
Equipment Selection/ Design Freeze
Equipment Installation
Design and Construction
Ship Life Cycle

- Increased market "exposure" & small market strength
- Increased emphasis on **Technology Refresh** & **Insertion**
  - Response to COTS / Market changes
  - Response to Mission changes
  - Response to New Technologies (evolutionary and

OSA is a large component of the answer

Open System Benefits

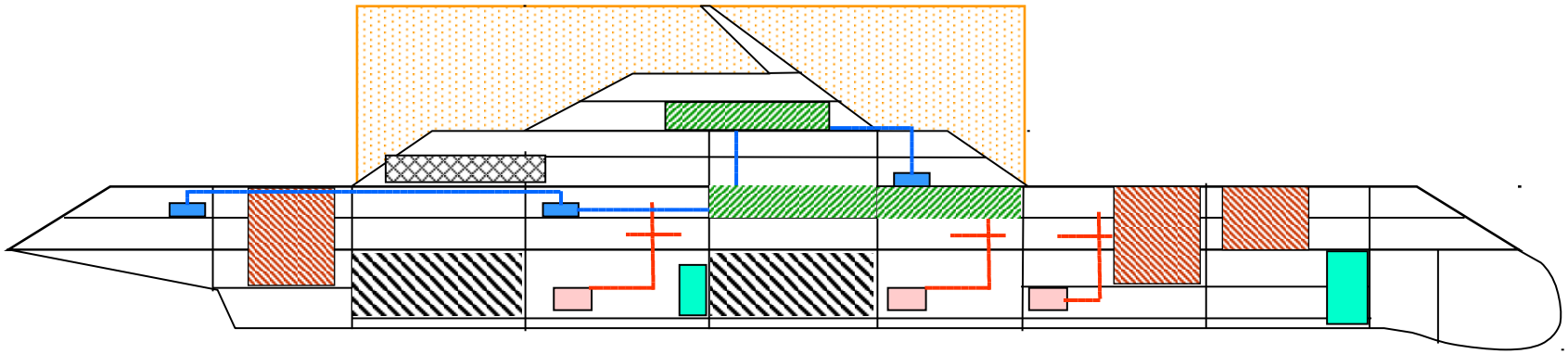
- **Flexibility**
  - Allows access to multiple vendors at system and component level
    - Competition during acquisition and over lifec
    - Avoid sole source constraints
- **Upgradability**
  - Allows new technology to be inserted cost e
  - Does not limit industry's ability to innovate
- **Scaleability**
  - For future upgrades
- **Affordability**
  - Reduces procurement costs
  - Reduces production costs
  - Reduces construction costs
  - Reduces O&S costs



Projected Cost Savings based on studies to date:

Acquisition : 20 - 25%

TOSA Vision: The Adaptable Ship



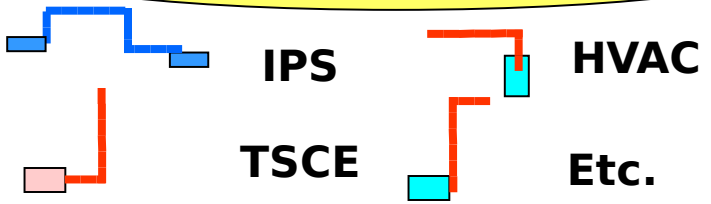
Open Zones

- Ordnance
- Machinery Equipment
- **C4I**
- Organic Off board Vehicles (OOV)
- Topside
- Other

Open Modules

Various

Open Distributed Systems



+Monitoring **+Maintenance** **+Supply**

Need for Supply, Maintenance and Monitoring Open Architecture

- Increased **operational readiness** – particularly when optimal manning is specified (e.g.DDX).

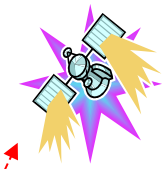
- Use **Open Standards** for better **Interoperability and technology upgrade & refresh**._

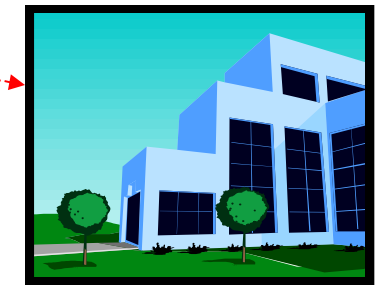
- **Optimal efficiency for shipboard maintenance and supply functions**
  - Condition assessment
  - Condition-Based maintenance
  - Automation of supply functions (such as inventory and parts ordering)

- **Solutions must be acceptable** to both system integrators and component manufacturers for new ships and compatible with on going ISEA programs.

SMMOA Vision

Fleet Support





ISEAs / FTSCs

Supply

Tech Data Library

Config Data Mgr

Personnel

SUPPLY

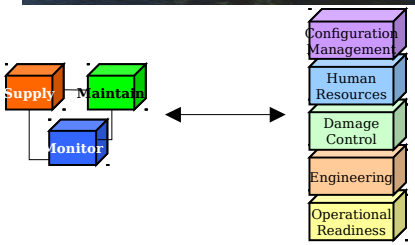
CM

Personnel

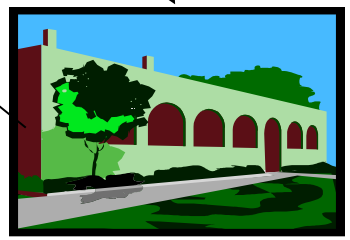
Maintenance

Monitored Data

JIT Parts
Maintenance Assist
CBM
Accurate CM Data
Tech Infusion
Tech Data Update
Training Assist



Benefits of open information exchange

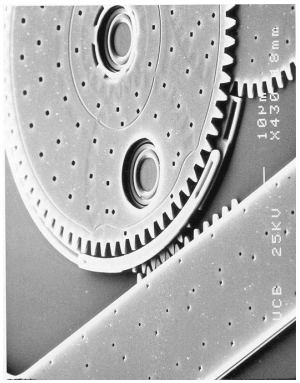


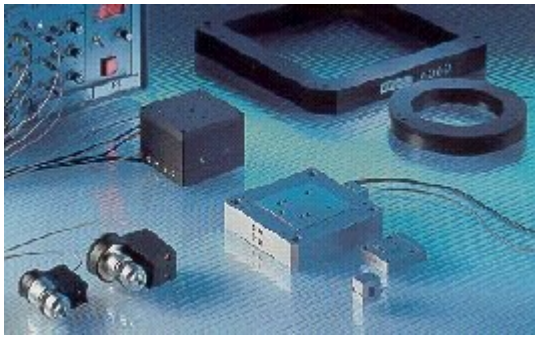
Vendors

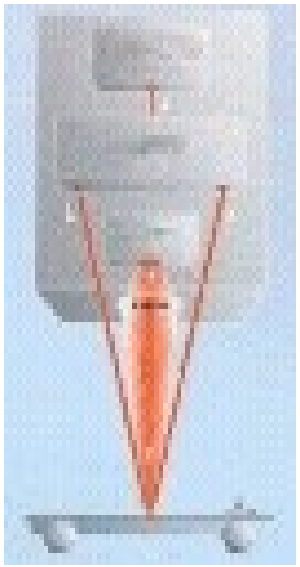
SMMOA Elements

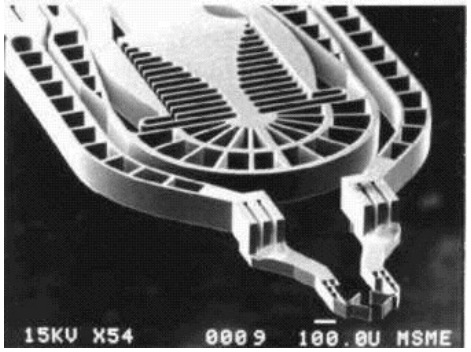
- TOSA has established the following elements as part of the SMMOA Focus Area Team:
  - **Open Sensor/Network Interface** (OSNI) Development
  - **Open Material Condition Information** (OMCI) Development [For Condition Based Maintenance]
  - **Open Logistics Support Interface** (OLSI) Development

Open Sensor/Network Interface (OSNI) Development









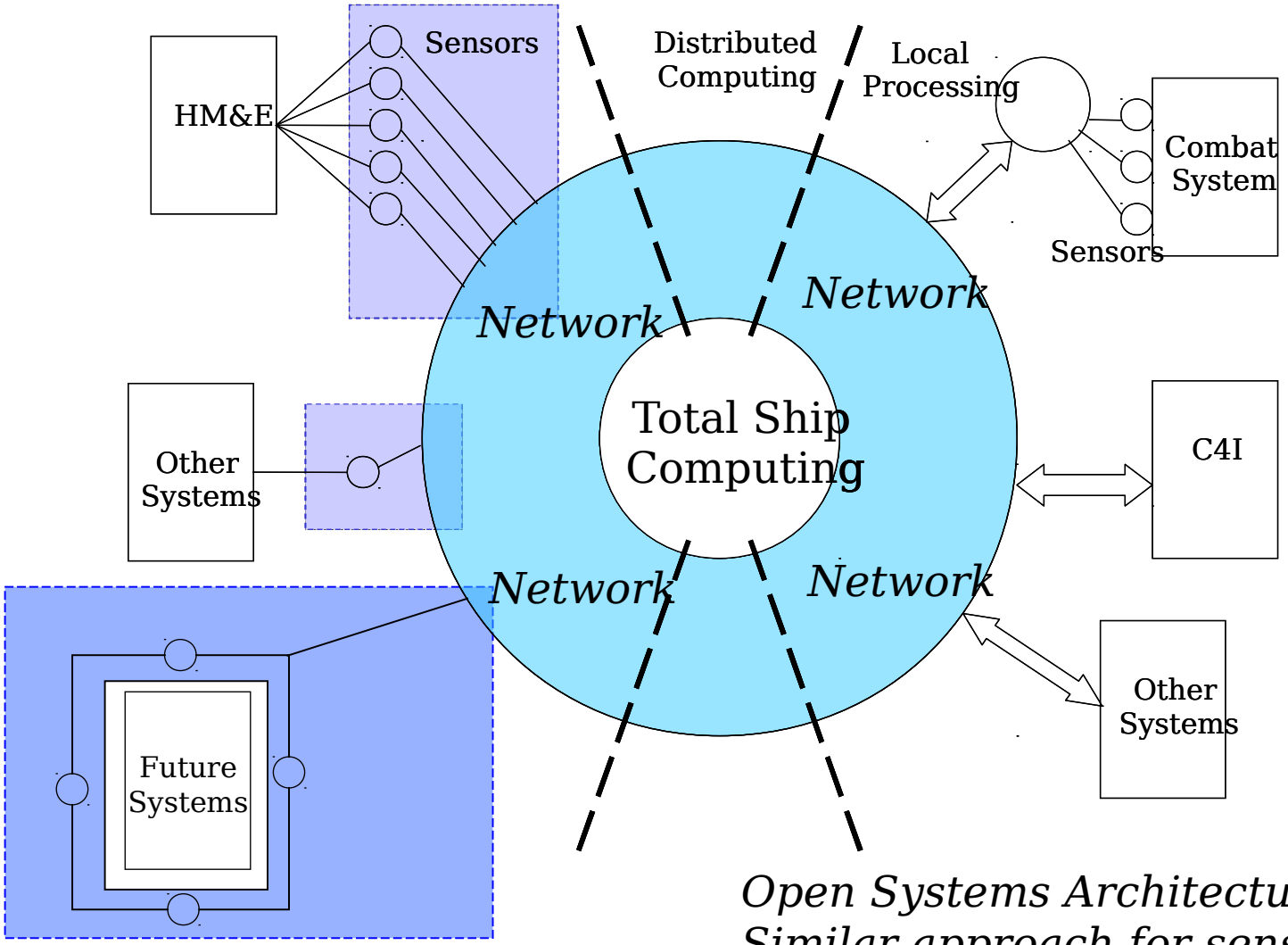
Automation and Open Architecture

- **Reduced/optimized** manning requirement for future ship classes drives for increased **automation**.
- Increased automation will require a significantly **increased number of transducers** installed aboard ship
  - Possibility of **25,000 (or more)** transducers on DD(x) class of ships
  - Levies unique requirements for future Naval platforms
- **Open architecture** approach will be key to achieving vision of highly automated ship in a cost effective manner
  - Reduced installation costs
  - Allow for Technology Insertion / Upgrade
  - Allow for streamlined Maintenance & Supply

OSNI Goals & Objectives

- Explore various **sensor-bus standards & interfaces**
- Perform **Risk Mitigation** on candidate sensor-bus standards
- Help establish a set of **Navy Open Architecture sensor-bus standards & interfaces**
- Work with **Standards Bodies** to develop Open Sensor-Bus Standards for both Industry and Navy
- **Promulgate the use** of sensor-bus standards for Navy systems to shipyards, systems integrators and vendors

Open Sensors/Networks and Total Ship Computing (TSCE)



Open Systems Architecture Approach f
Similar approach for sensors/sensor ne

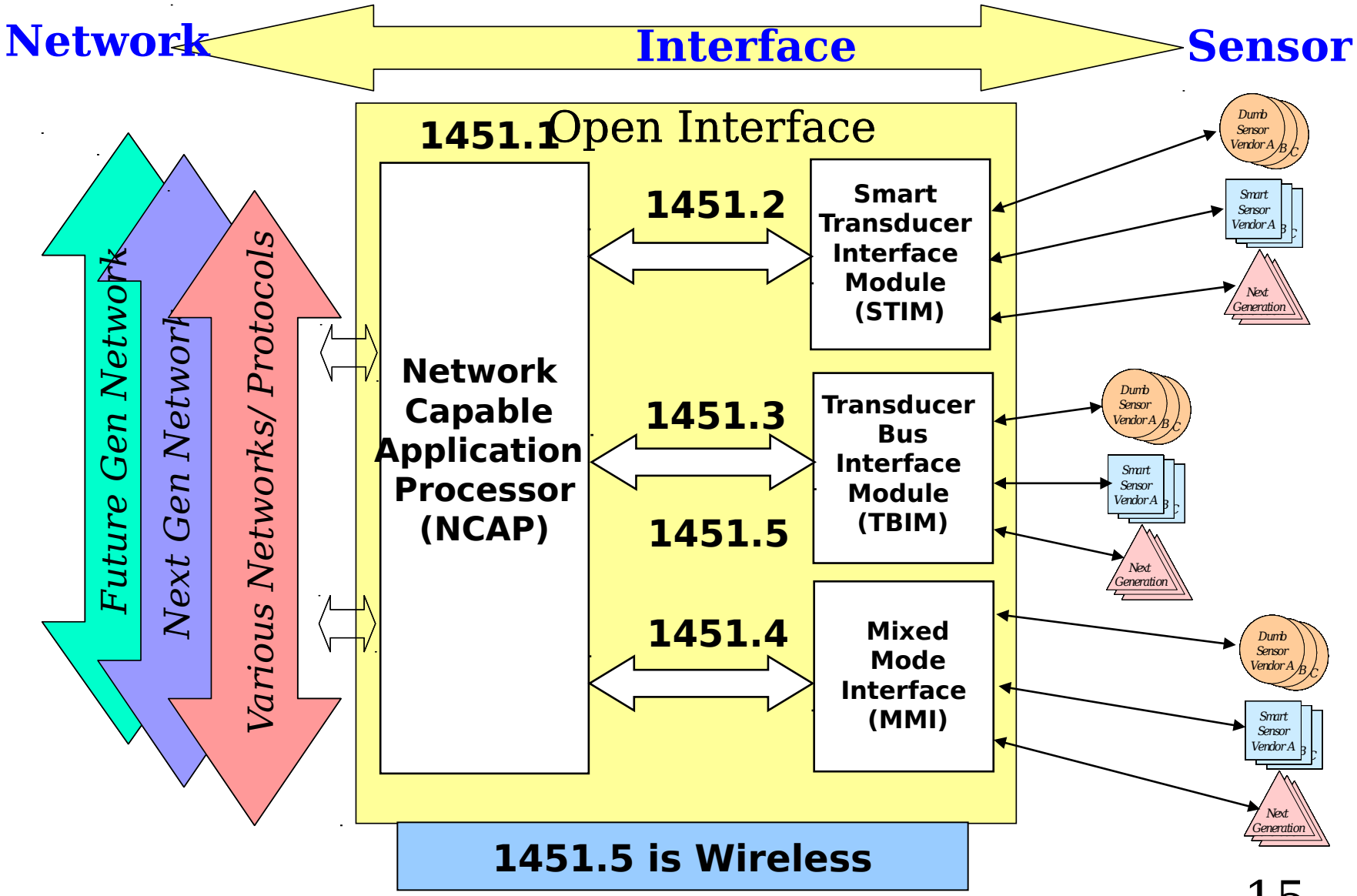
OSNI Initial Focus on IEEE 1451 Family

We have chosen our initial focus on the IEEE 1451 family:

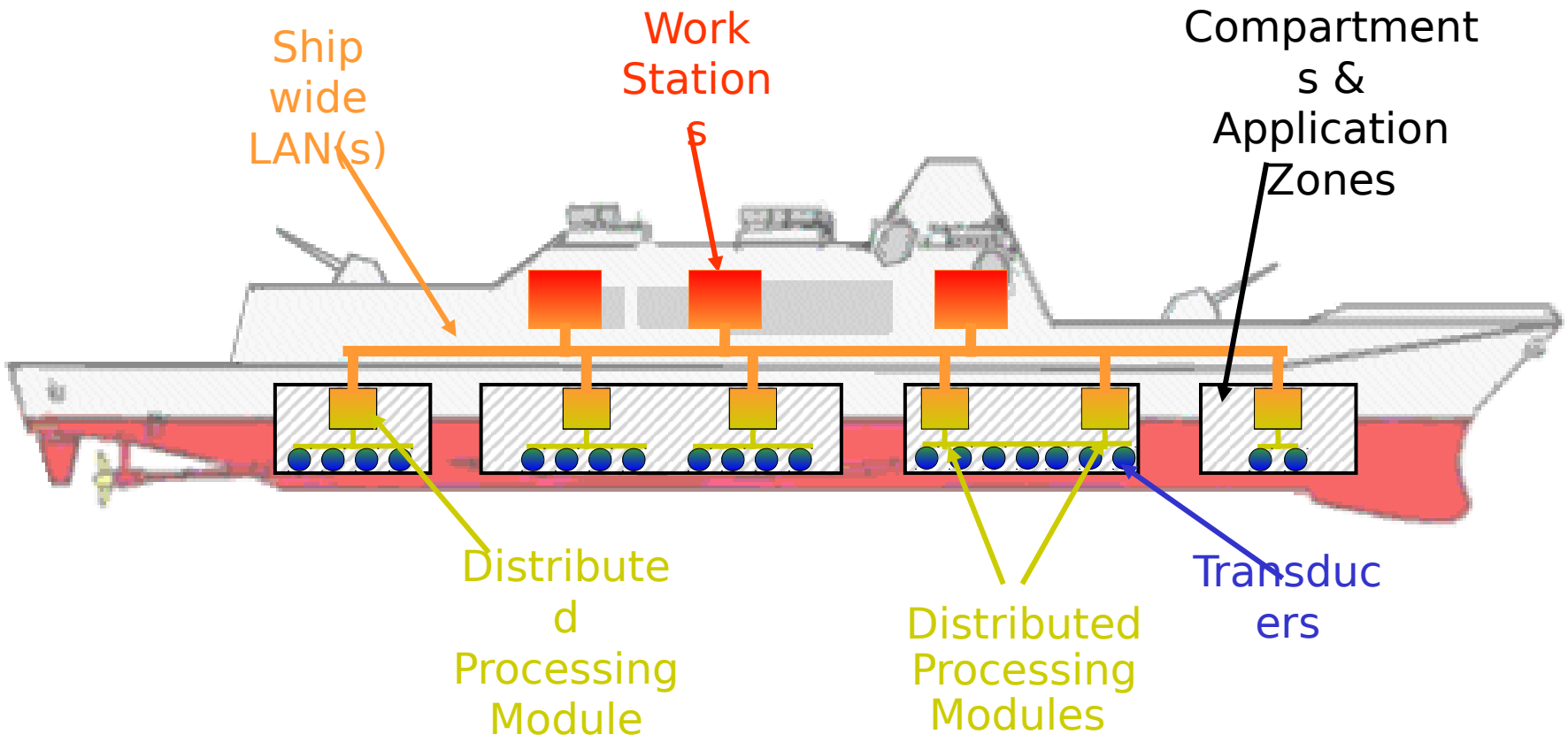
- The IEEE 1451 sensor-bus network family attempts to address interoperability issues
- **1451 family allows for interoperability among different network AND transducer manufacturers**
- 1451 family allows for plug & play of transducers *and* network
- 1451 family allows for easy upgrade
- Development of the 1451 family is evolving

OSNI chose to focus on IEEE 1451 as a candidate *open interface* sensor/network

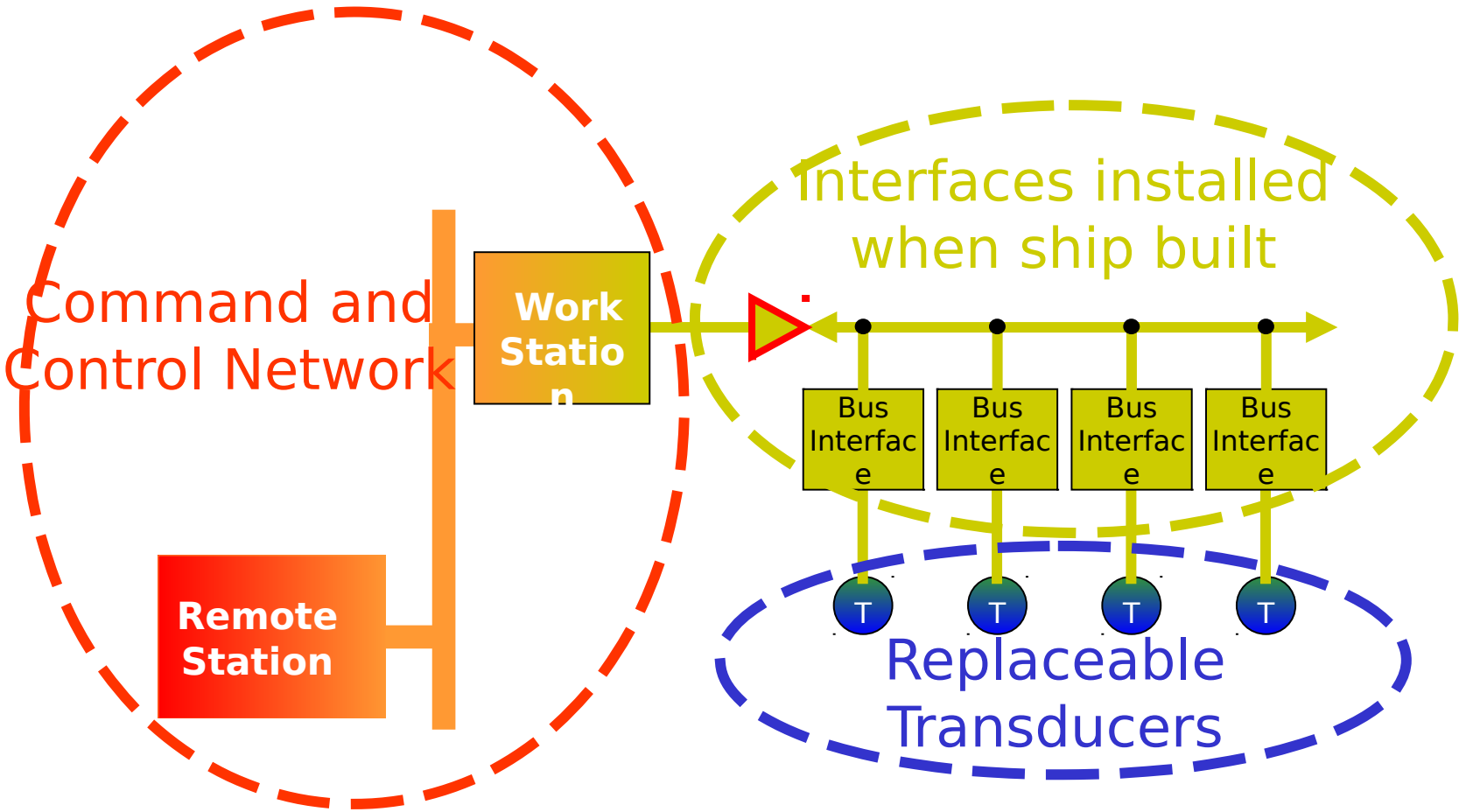
IEEE 1451 Standards Family



Distributed Sensor-bus Network



Modular Sensor-bus Interfaces

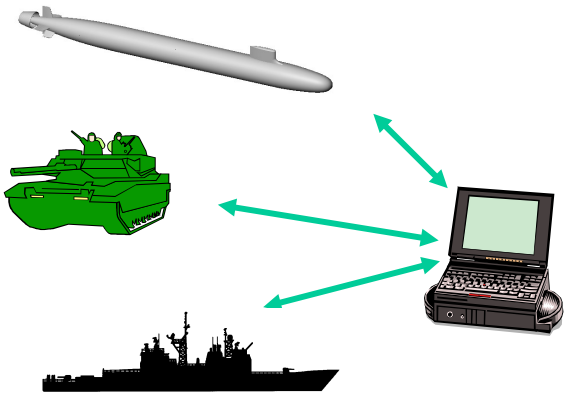


Initial Risk Mitigation

- **Development of an Open Sensor/Network Interface Demonstrator**
  - IEEE 1451.3 (multi-drop bus) chosen for testing
    - Used an early draft of the standard (2001)
  - Examine and explore Navy needs and requirements
    - Tested a concept of additional backup features added to help address Navy specific issues
    - Help demonstrate the use of plug-and-play for sensor-bus networks
  - Adapted existing COTS parts and systems to simulate IEEE 1451.3 network
    - Pressure & Temperature sensors
    - Encoder & Stepper motor actuators

OSNI Demonstrator

Open Material Condition Information (OMCI)



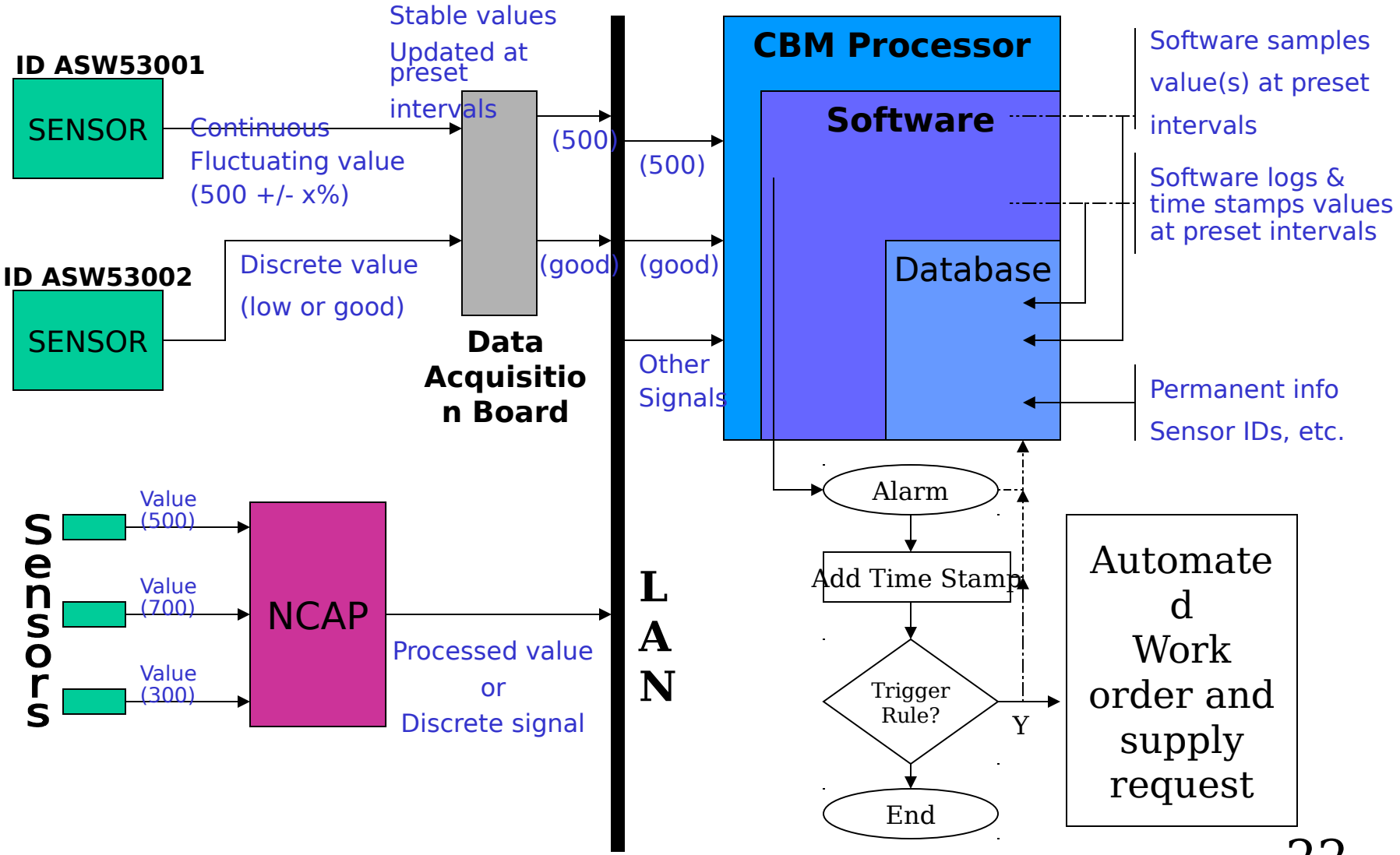
MIMOSA

OMCI Requirements

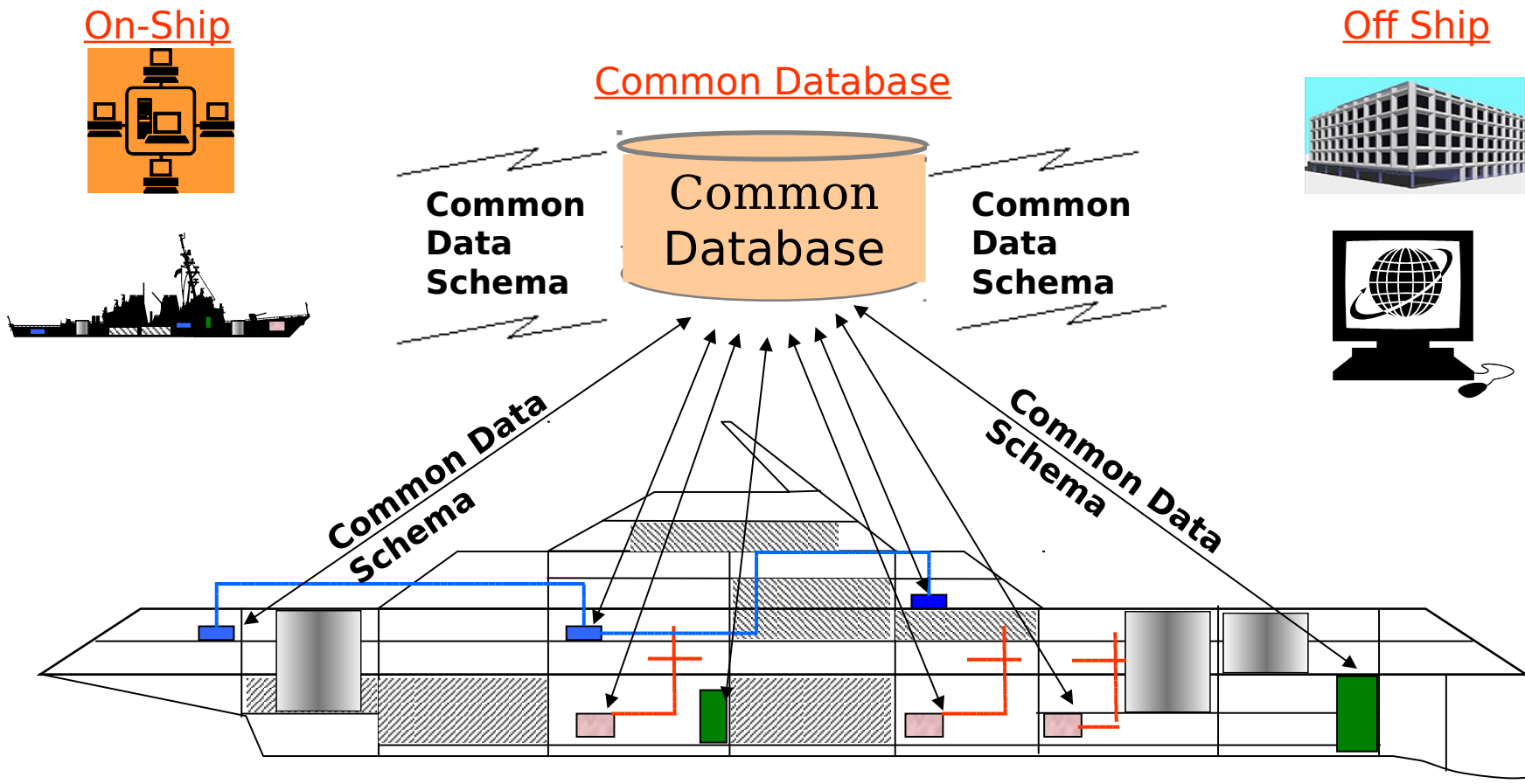
- Need to **reduce/optimize manning** for DDX
- Need to **reduce maintenance man-hours**
- Requires more **Sophisticated and Extensive Maintenance Applications**
- There are **multiple Navy and commercial maintenance information interfaces**
- Maintenance developments *including* future Condition Based Maintenance (CBM) applications require:
  - Access to expanding commercial developments.
  - Interoperability between commercial CBM systems and maintenance information systems.
  - A Navy/commercial standard interface for maintenance ap

An Open Material Condition Information Standard is Required

Material Condition Information Data Flow



Open Material Condition Information



A common database information schema for all ***material condition information****, NOT just CBM data.*

Integration of CBM and Information Systems

Information Interoperability

Military Market Surveillance/ Technology Projection

Navy Development Efforts

- Total Ship Monitoring (**TSM**)
- Battle Group Automated Maintenance Environment (**BG-AME**)
- Enterprise Resource Planning (**ERP**)
- DDX
- Etc.

Working Groups

- Gas Turbine Working Group
- Maintenance Engineering Technology Team (SEA04M)
- Joint Wireless Working Group (SPAWAR)

R&D Programs

- Reduce Ships crew through Virtual Presence **(RSVP)**
- SMARTSHIP Initiatives
- Submarine Towed Arrays
- Submarine Maintenance Monitoring Program
- Etc.

Other CBM Data Activities

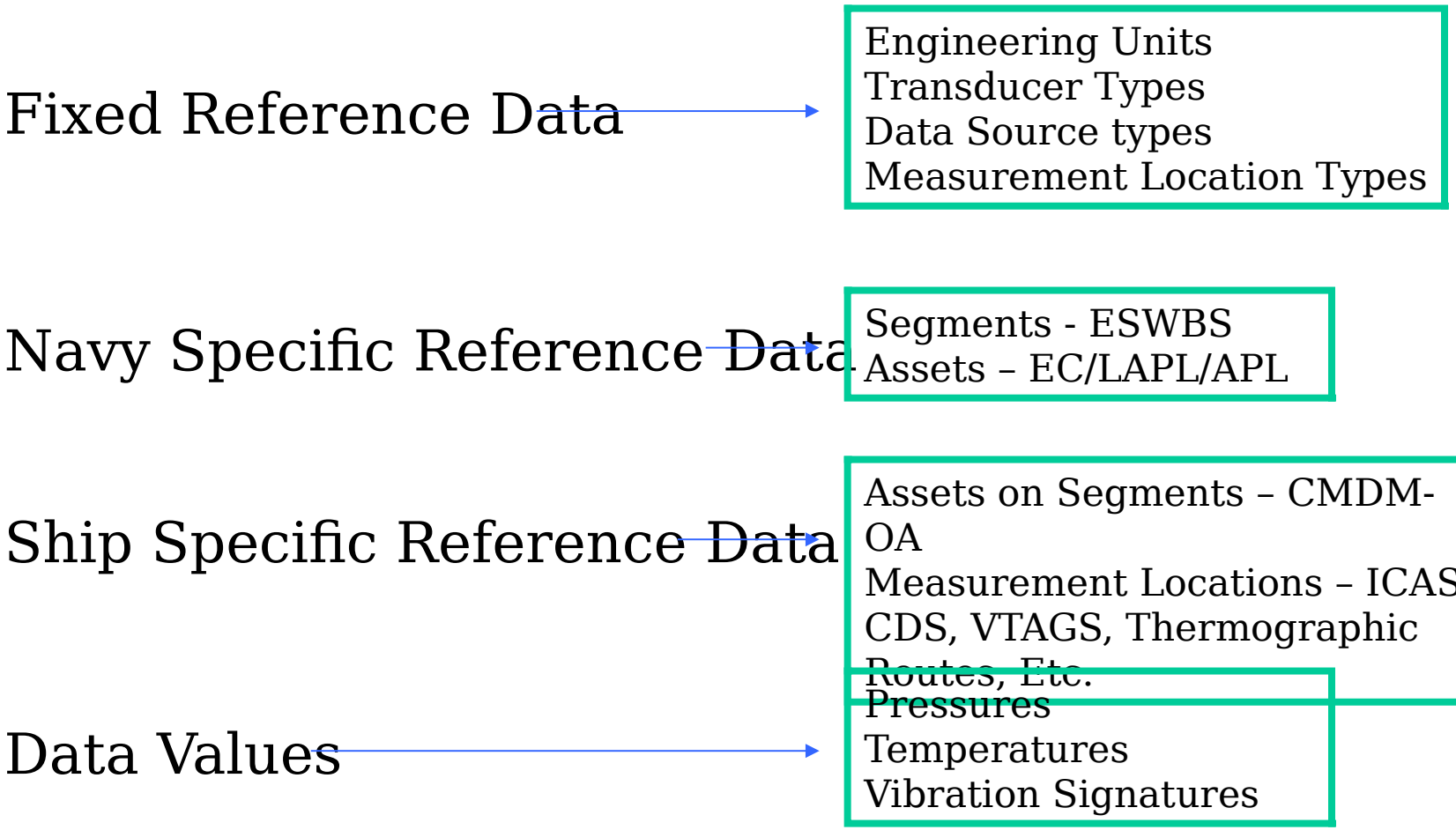
- Army Diagnostic Improvement Program
- AAAV
- JAHUMS
- OSA-CBM
- MIMOSA
- Etc.

MIMOSA

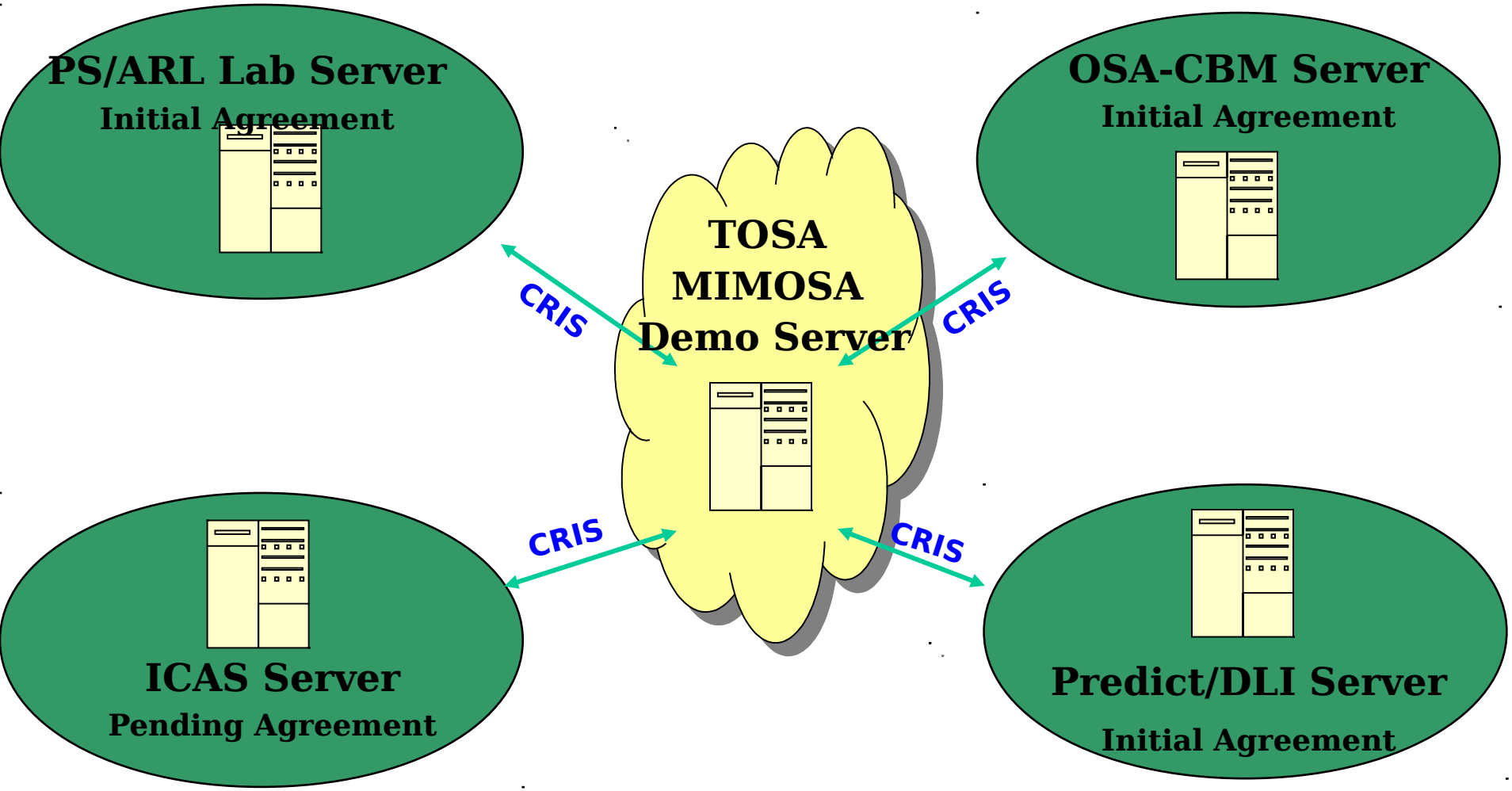
- Maintenance Information Management Open Systems Alliance
- Consortium of 50+ system integration providers, component vendors and end-users
- MIMOSA addressing the interoperability deficiency in information integration and exchange.
- Developing open specifications for all material condition information, not just CBM
- MIMOSA goal to become an ***ISO Standard***

SMMOA Selected MIMOSA as a Candidate Navy OMCI Standard

MIMOSA
Database Structure



OMCI Server Demonstrator



Goal: Demonstrate Information Interoperability

Open Logistics Support Interface (OLSI)

Transportation Modes

Land
- •Rail
- •Trucks/trailers

Sea
- •Ships
- •Barges
- •Craft

Air
- •Fixed Wing
- •Helicopter
- •Tilt Rotor

3

New Support Paradigm

Navy Design
Navy CM Control
Full Data Disclosure
Stable Technology
Stable Supplier
Support Bit &Piece
Maintenance
Organic Support

Legacy MILSPEC Support System

Vendor Design/CM Control
Limited Data Disclosure
Limited Supplier Stability
Rapid Technology Change

COTS Acquisition (Mid 90's)

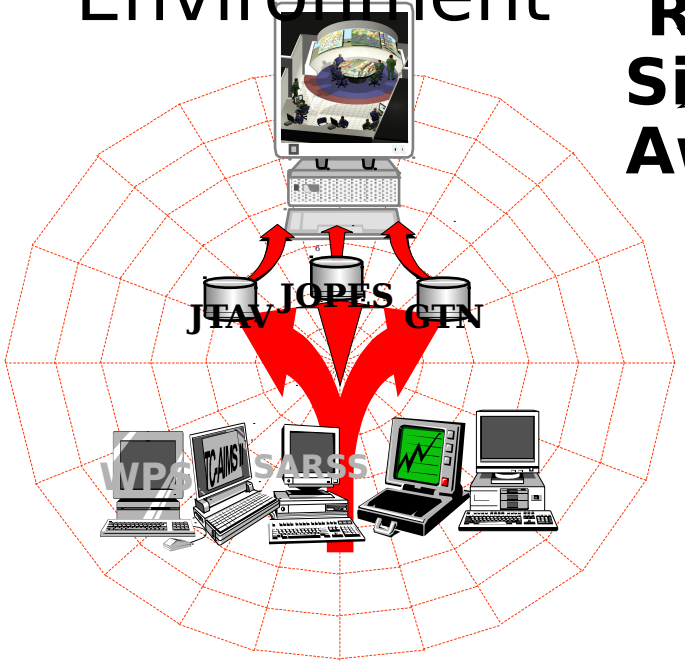
Modular Maintenance
Organic/Contractor mix

"TOSA Enabled" Acquisition (Year 2010)

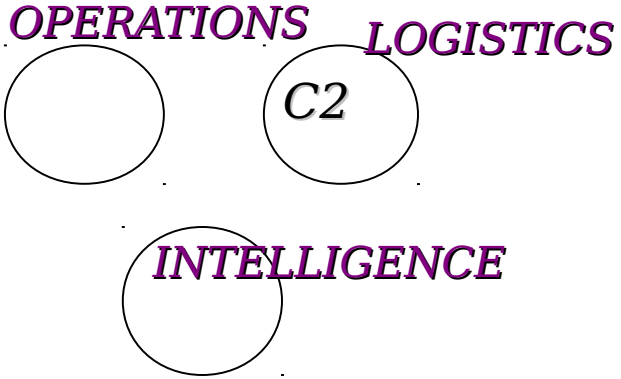
Performance Based Contracting
Multiple Suppliers
Rapid Tech Insertion
TOSA Interface Specs
Condition Based Maintenance
Global Information Grid

OLSI Vision

Network Centric Logistics Environment



Integrated Real-Time Situational Awareness



VADM Holder Director of Logistics The

Logistics Requirements

- Reduced Manning
  - Necessary to automate Logistics
- Ability to ***see*** assets while in storage or transit
  - Streamlined Acquisition & Tracking Management
- Increase Operational Readiness
  - Accountability for necessary items
  - Ability to obtain items from multiple sources
- Utilize Open Standards
  - Increased Life Cycle Support
  - Reduced Total Ownership Costs
  - Interoperability between different systems

OLSI Goals

- Integrate supply support with material condition monitoring and maintenance data bases to enable exchange of data and interoperability
- Advance the use of open standards for critical interfaces
- Enhance asset visibility to reduce cost and enhance readiness
- Automate supply chain management through use of Material Handling Equipment and

Leverage industrial and government best practices, new technology, and emerging standards

Market Surveillance & Technology Projection

- Universal Identification (UID) part marking
- Universal Identification Code
- Smart stores/smart shelves
- Radio Frequency Identification (RFID)
- Ultra Wide Band (UWB)
- Serial Number Tracking
- Data Matrix Symbology
- Contact Memory Buttons
- AIT networks
- Material handling equipment

Container lifting systems

Sponsor/Mfg: Hyster

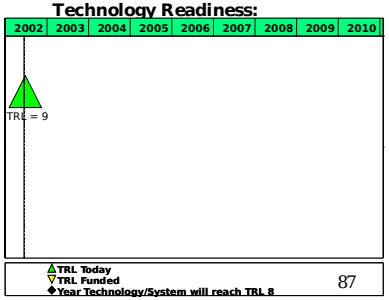
Description

Reach Stackers
Suppliers from
http://www.hyster.com/dealers/

Characteristics:

Container lifting system stacks containers onto vehicles and ground.

Technology Readiness:



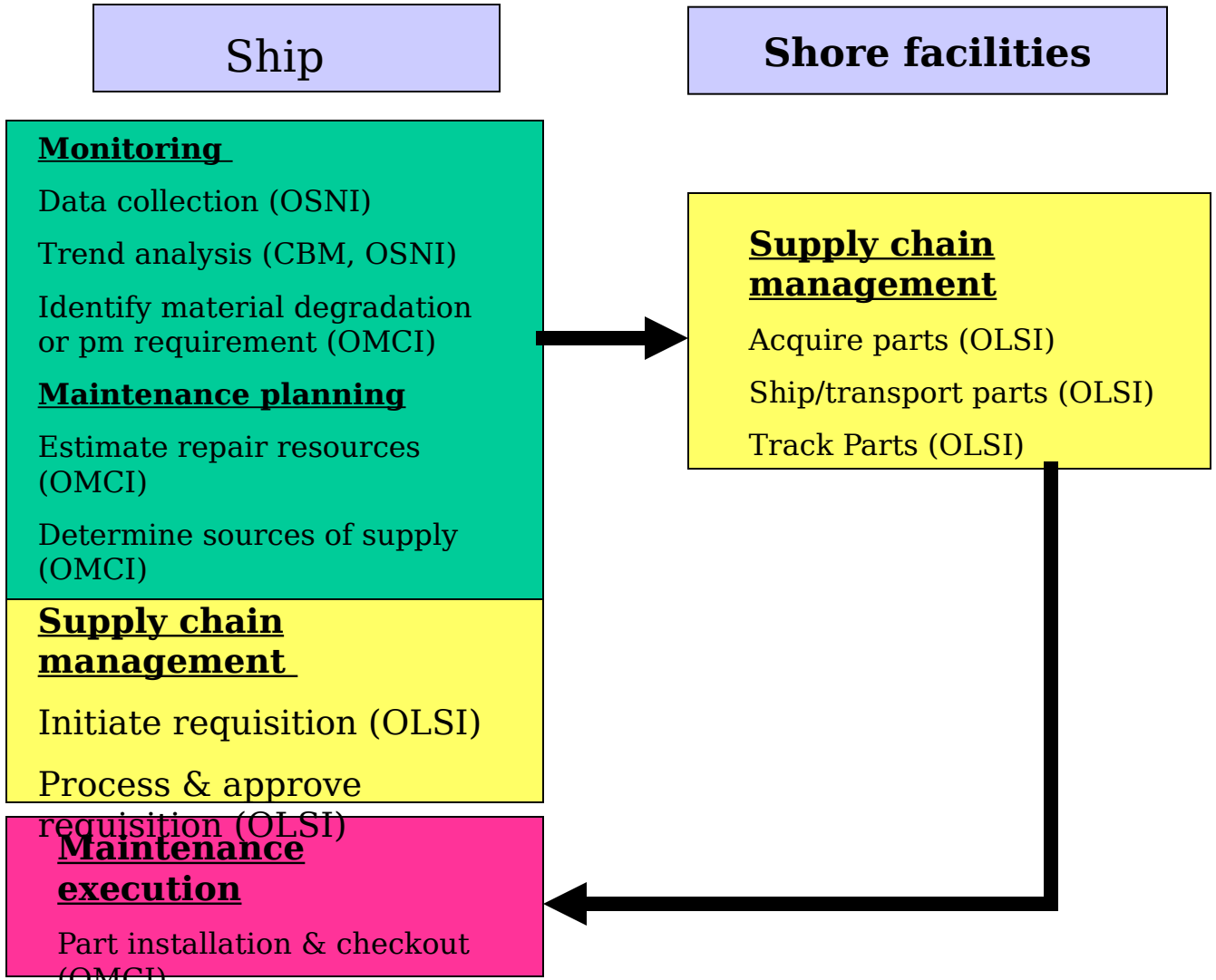
January 3, 2003

OLSI's Use of Open Standards

- Review and evaluate evolving standards for AIT, inventory management, MHE, storage & transportation

- Become involved in standards development
  - Better interoperability between systems
  - Insure various Logistics systems communicate with each other
    - From hand-held bar-code readers & CMBs to databases to communications systems

Integrated Supply, Maintenance, and Monitoring Workflow



ILS Scenario Major Unplanned Maintenance

ENCODED

CBM ONBOARD

RAPID RESPONSE

CONDITIONED BASED MAINTENANCE SURVEILLANCE TEAM

Global Readiness Center

IN PLACE CONTRACTS

VENDOR A

VENDOR B

VENDOR C

Rapid Response Team

Conclusion

- **SMMOA is a Prime Concern for Navy's future**
  - Future Manning requires better use of technology for monitoring, maintenance and supply
  - Open Standards should be developed/used for interfaces
  - Need risk mitigation on candidate Open Standards
  - Need to reach common Agreements & Strategies
  - Consensus set of Standards for SMMOA
    - Open Sensors, Databases and Supply & Logistics management
  - Promulgate these standards to Naval and Industry Systems Integration Teams

Contact Information

- SMMOA Contacts

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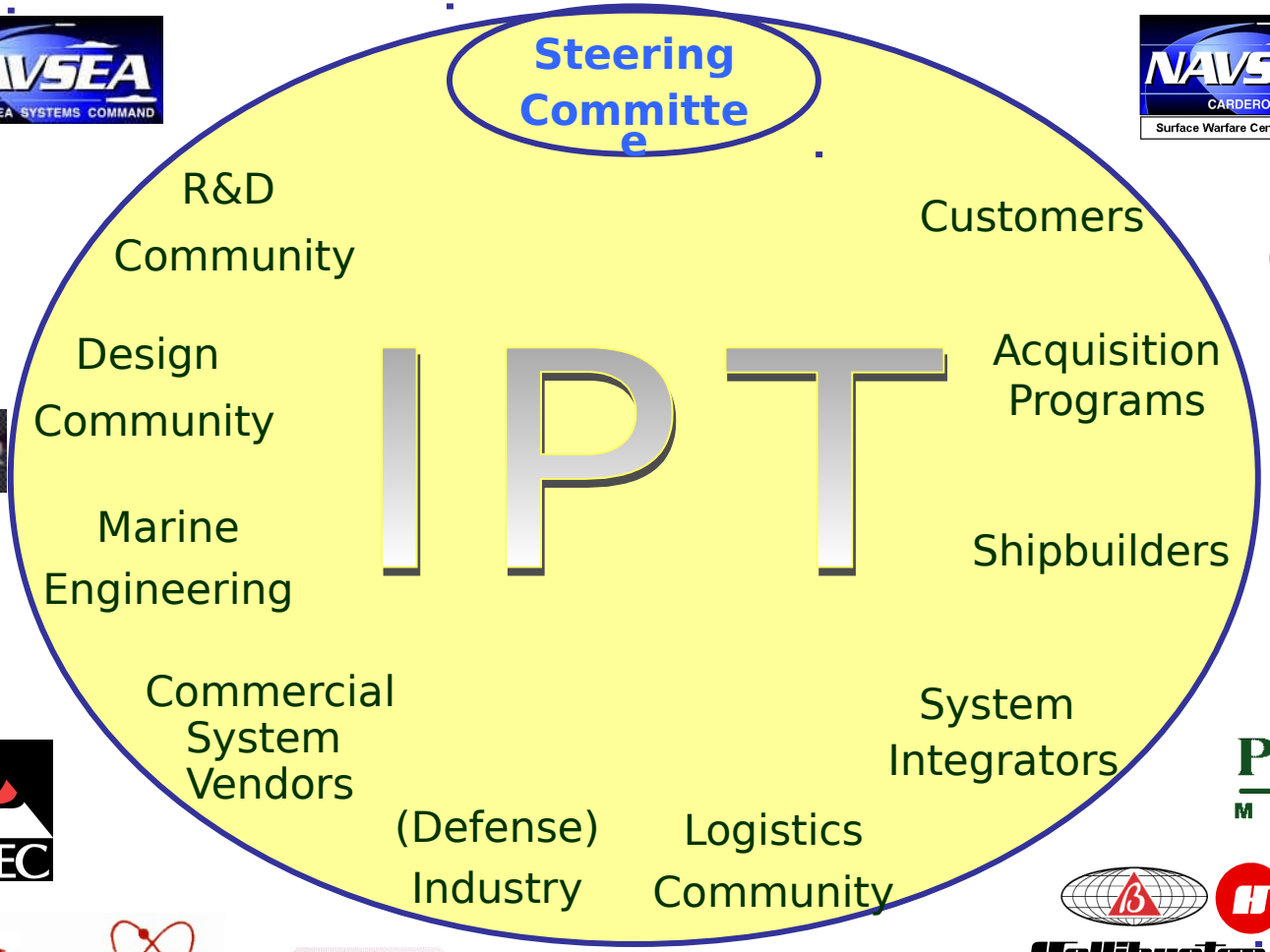
AbbottJW@nswccd.navy.mil

Backup

TOSA Industry-Navy Integrated Product Team



NAVSEA NAVAL SEA SYSTEMS COMMAND

NAVSEA DAHLGREN Surface Warfare Center Division

NAVSEA CARDEROCK Surface Warfare Center Division

PROGRAM EXECUTIVE OFFICE FOR SURFACE STRIKE PEO (S) PRIDE INNOVATION DETERMINATION

NAVAIR

NAVSEA PANAMA CITY Coastal Systems Station

ICAS

CSC

AMSEC

Prime, Inc. M I D A S

AOC

BIW

NORTHROP GRUMMAN Ship Systems

Halliburton Company

OSA Examples

Closed Systems

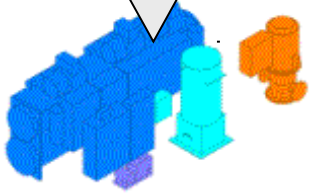
Mil-Std 200 ton A/C Plant

UYK-44

Direct Drive Propulsion

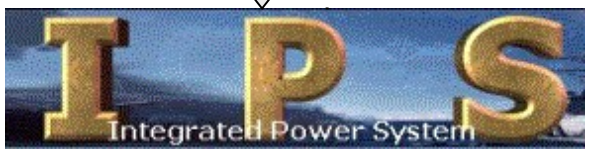
A/V-8B Avionics

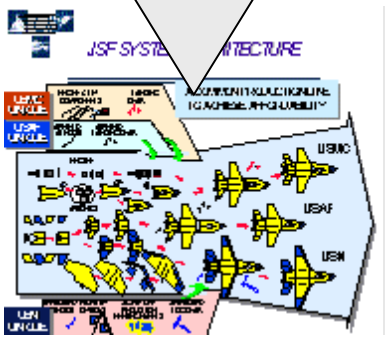
Open Systems



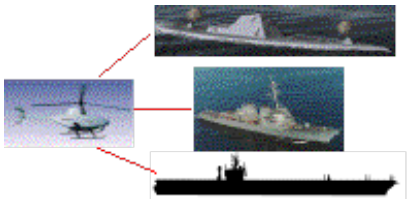
Chilled Water Module

UYQ-70

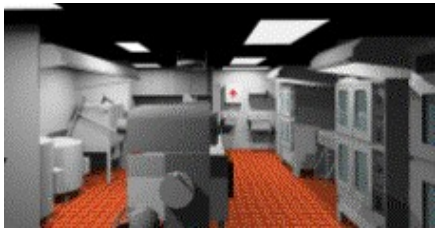




Joint Strike Fighter



Ship/UAV Interface



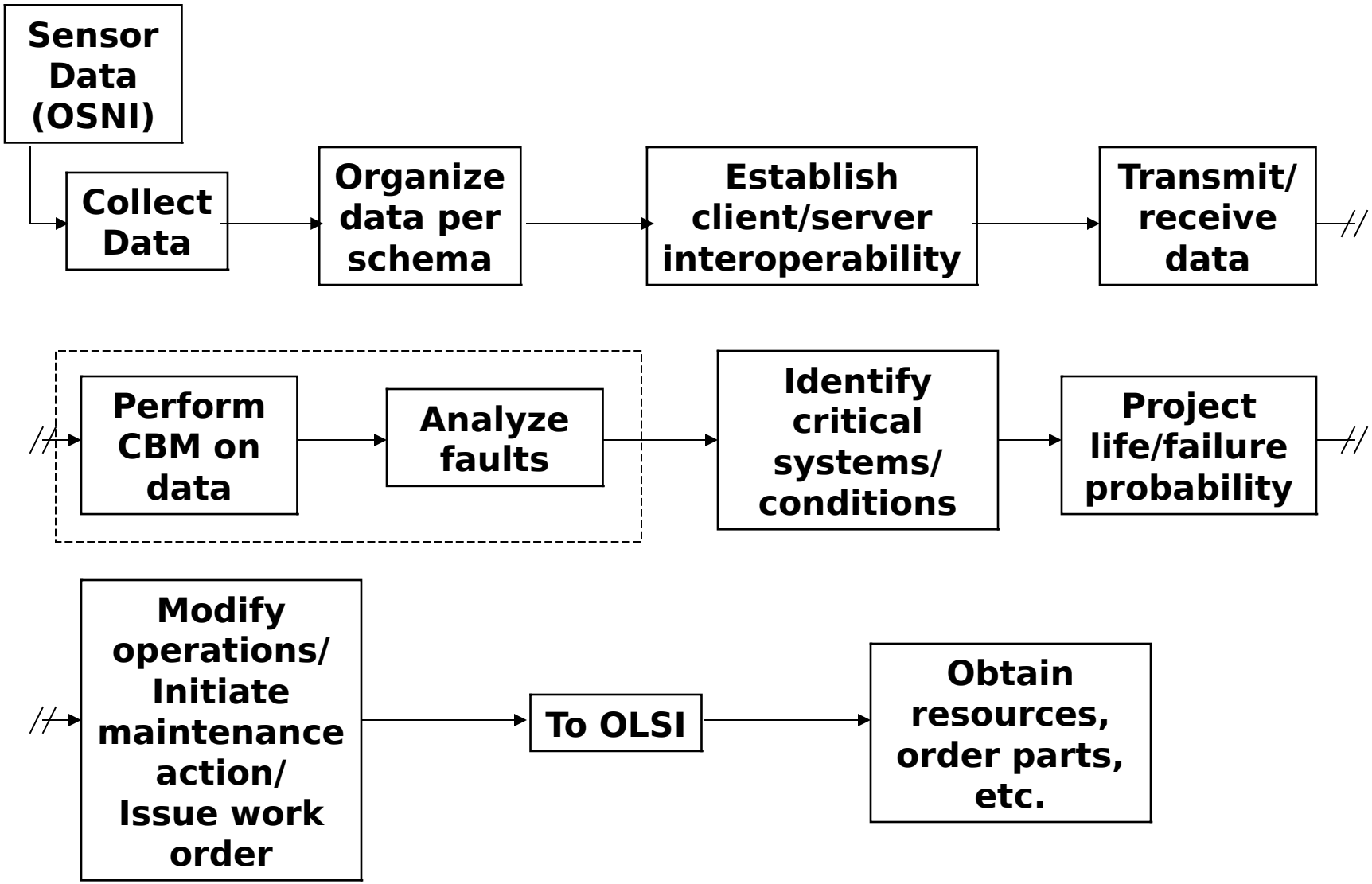
Advanced Food Service

Ship Habitability Module

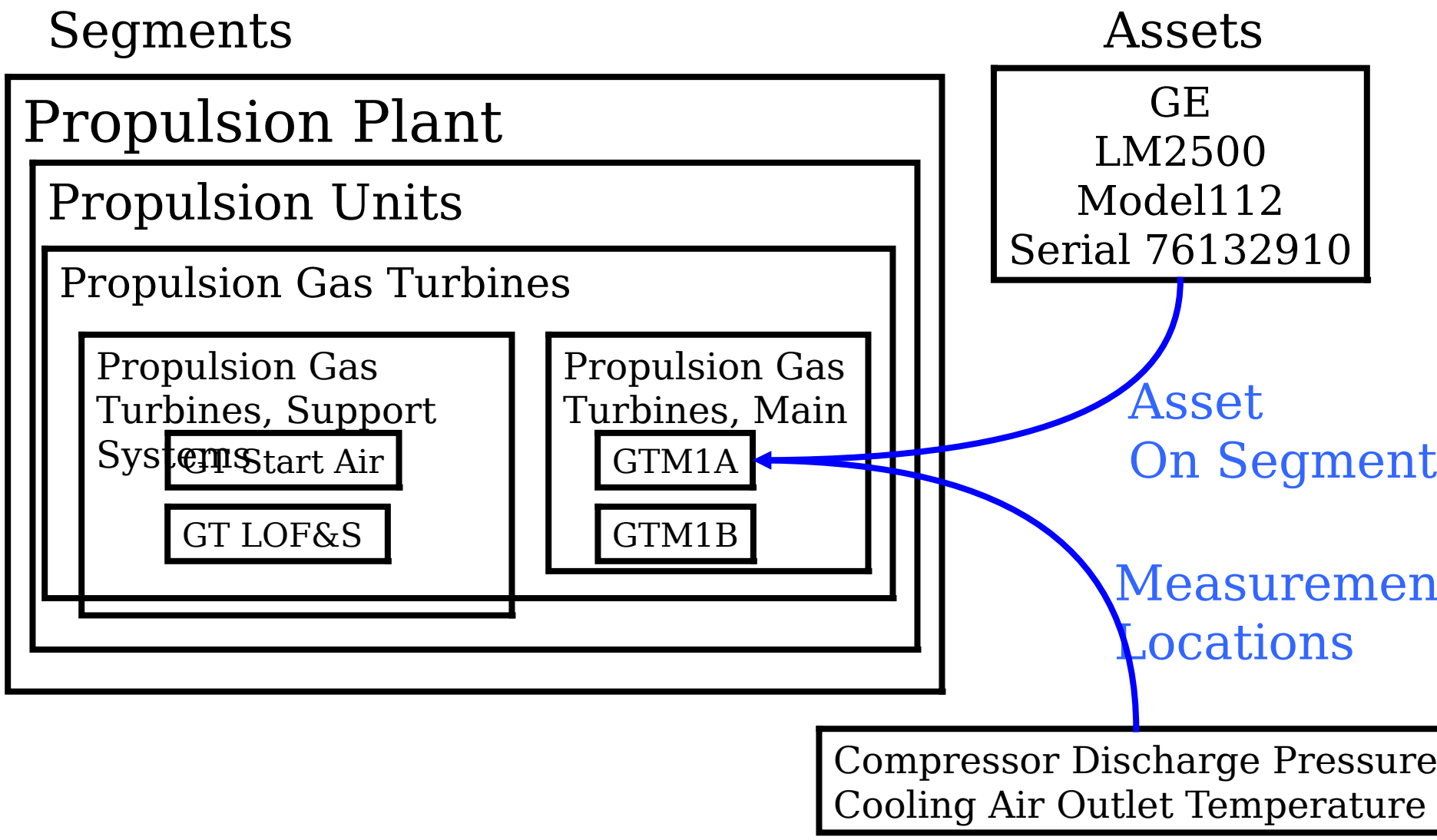
Background/Initial Research

- Began with a comprehensive market surveillance of CBM programs and projects
  - Identified key players and key programs in the CBM arena
  - Identified standards bodies and standards development work with potential TOSA implications
- Established contacts/working relationships with key CBM programs, projects, and companies
  - Commercial companies
  - Navy R&D projects
  - Other military service programs
  - Universities involved in CBM

OMCI Work Flow



MIMOSA
Database Structure



MIMOSA Implementation Issues

- MIMOSA is the gatekeeper for the fixed reference tables
- We need a gatekeeper for the Navy specific reference tables
- MIMOSA DB’s ship and shore have to be maintained as ship configuration changes
- Application software is needed to simplify setup of the MIMOSA database
- Hooking up real-time data acquisition to demo server
  - 1451 demonstrator
  - PS ARL
  - Predict DLI
  - ICAS

MIMOSA Interfaces

- MIMOSA defines interfaces for the following “technologies”
  - Trend – static values (pressure or temperature and alarm values)
  - Dynamic – spectral values (vibration, ultrasonic, electric current)
  - Sample – fluid tests such as oil analysis or gas tests
  - BLOB (binary large objects) – graphic files (thermographic or digital camera images)
  - Diagnostic – text values (diagnostics and recommendations)
  - Reliability – FMEA information
  - Registry – asset management information
  - Work – work management information

- MIMOSA Compliance is determined on a technology by technology basis
  - Not all applications use all “technologies “